Decision Rationale
Total Maximum Daily Load for
Fecal Coliform for the Goose Creek Watershed

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA's) rationale for approving the seven fecal coliform TMDLs for the Goose Creek watershed. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual wasteload allocations (WLA) and load allocations (LA).
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a MOS.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

II. Background

The 246,000 acre Goose Creek Watershed is located in Fauquier and Loudon Counties. Goose Creek is the largest tributary to the Potomac River in Virginia downstream of the Shenandoah River. The TMDL addresses the main stem of Goose Creek and six of its tributaries, Beaverdam Creek, Cromwells Run, Little River, North Fork of Goose Creek, Sycolin Creek, and South Fork of Sycolin Creek. Agricultural and forested lands make up roughly 97% of the 246,000 acre watershed.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed Goose Creek, Beaverdam Creek, Cromwells Run, Little River, North Fork Goose, and Sycolin Creek on their 1998 Section 303(d) list for failing to attain the primary contact use due to the presence of elevated levels of fecal coliform. The South Fork of Sycolin Creek was listed on

Virginia's 2002 Section 303(d) list as failing to attain the primary contact use due to the presence of elevated levels of fecal coliform. Goose Creek and Little Creek also failed to attain the aquatic life use due to an impairment of the benthic community. The aquatic life use impairments will be addressed by another TMDL.

All of these Creeks were listed for violations of Virginia's fecal coliform water quality criteria. Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth has adopted e-coli and enterococci criteria. Streams will be evaluated via the e-coli and enterococci criteria after 12 samples have been collected using these indicator species. The fecal coliform criteria will be used in the interim.

As Virginia designates all of its waters for primary contact, all waters must meet the current fecal coliform standard for primary contact. Virginia's standard applies to all streams designated as primary contact for all flows. The fecal coliform criteria was modified in 2002 to require that the fecal coliform concentration not exceed a geometric mean of 200 colony forming units (cfu) per 100 milliliters (mL) of water for 2 or more samples collected over a month nor shall more than 10% of the total samples exceed 400 cfu/100 mL of water. The new e-coli criteria requires a geometric mean concentration of 126 cfu/100mL of water with no sample exceeding 235 cfu/100 mL of water. Unlike the fecal coliform criteria which allows a 10% violation rate the new e-coli criteria requires the concentration of e-coli not exceed 235 cfu/ 100mL of water. The e-coli criteria was found to drive the TMDL allocations because its instantaneous criteria is far more stringent than the other criteria.

Although, the TMDL and criteria require the 235 cfu/ 100 mL of water not to be exceeded waters are not placed on the Section 303(d) list if their violation rate does not exceed 10%. Therefore, the Creeks may be deemed as attaining their uses prior to the implementation of all of the TMDL reductions. It is necessary to keep this in mind because of the reductions needed to attain the instantaneous criteria for e-coli. The TMDLs call for a 100% removal of cattle in stream, straight pipes, and failing septic tanks. The TMDLs also require between a 98% and 99% reduction in fecal coliform (e-coli) delivered from pastures. The elimination of fecal coliform (e-coli) entering the streams from upland pastures is something that neither the EPA nor the state expect to be able to attain. However, EPA does not expect these reductions to be needed because of the listing protocols discussed above and items associated with the model. In an attempt to reduce the impacts associated with extreme low flow events stream flow was modeled as never being less than 0.001cubic foot per second (cfs).

Problems calibrating the model to lower flows and the impacts of direct deposition sources during these flow events validate this assumption.

The TMDLs for the Goose Creek watershed will be incorporated into the applicable water quality management plan according to Section 303(e) of the CWA. The Commonwealth plans on pursuing a phased implementation to implement the reductions called for in the TMDLs. A phased implementation plan will allow the Commonwealth to evaluate and document the results of best management practices (BMPs) on the loadings. This will enable the Commonwealth to target funding and actions to the systems and locations that are determined to be most applicable for attaining water quality criteria. Phase 1 of the implementation calls for no more than 10% of the samples collected from the impaired segments to be violating the instantaneous criteria for e-coli and fecal coliform. According to the water quality model, this is expected after the removal of cattle from the stream, the repair of failing septic systems, and a 50% reduction in bacteria loading from pasture. The Commonwealth will continue to monitor the streams within the Goose Creek Watershed to insure the attainment of the applicable criteria.

The Goose Creek Watershed was identified as stream segment numbers VAN-A05R to VAN-A08R and given a high priority for TMDL development. Section 303(d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the state where technology-based and other controls do not provide for the attainment of water quality standards. The TMDLs submitted by Virginia are designed to determine the acceptable load of fecal coliform which can be delivered to the Goose Creek and its impaired tributaries, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. Wastes which are deposited directly to the stream do not need a transport mechanism. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream, straight pipes and failing septic tanks, and specific landuses.

Table 1 - Summarizes the Specific Elements of the TMDL.

Stream	Parameter	TMDL	WLA	LA	MOS
Cromwells Run	Fecal Coliform	9.80E+12	0	9.80E+12	Implicit
North Fork Goose Creek	Fecal Coliform	1.73E+13	1.94E+12	1.54E+13	Implicit
Beaverdam Creek	Fecal Coliform	3.73E+13	2.54E+11	3.70E+13	Implicit
Little River	Fecal Coliform	2.36E+13	2.76E+09	2.36E+13	Implicit
Sycolin Creek	Fecal Coliform	6.23E+12	2.76E+09	6.22E+12	Implicit
South Fork Sycolin Creek	Fecal Coliform	1.41E+12	0	1.41E+12	Implicit
Goose Creek	Fecal Coliform	3.67E+14	3.17E+12	3.63E+14	Implicit

EPA believes it is important to recognize the conceptual difference among the WLA values, LA values for sources modeled as direct deposition to stream segments, and LA values for flux sources of fecal coliform to landuse categories. The WLA values and LA values for direct sources represent amounts of fecal coliform which are actually deposited into the stream segments. The HSPF model, which considers landscape processes which affect fecal coliform runoff from landuses, determines the amount of fecal coliform which reaches the stream segments. The LA in Table 1 is the amount of cfu reaching the edge of stream from nonpoint sources annually.

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a fecal coliform TMDLs for the Goose Creek Watershed. EPA is therefore approving these TMDLs. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality criteria and designated uses in the Goose Creek Watershed. The water quality criterion for fecal coliform was a geometric mean 200 cfu/100mL or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-day period, most of the samples are measured against the instantaneous standard. The Commonwealth has recently changed its bacteriological criteria as indicated above. The new criteria require that the fecal coliform concentration not exceed a geometric mean of 200 cfu per 100 milliliters of water for two or more samples collected over a month nor shall more than 10% of the total samples exceed 400 cfu/100 mL of water. The new e-coli criteria requires a a geometric mean of 126 cfu/100mL of water with no sample exceeding 235 cfu/100 mL.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the new fecal coliform and e-coli water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform
(e-coli) to Goose Creek and its impaired tributaries will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Data used in the model is obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, landuses, weather, stream geometry, etc.. The model then combines all the data to determine the hydrology and water quality of the stream.

Six landuse categories were used in the Goose Creek Watershed TMDL model. The six landuses were aggregations of the 13 landuses found in the watershed. The watershed was then divided into 25 subwatersheds. The segmentation was associated with stream mouths and gages. There are four United States Geological Survey (USGS) hydrologic gage stations in the watershed. Two of the gages are located on the main stem of Goose Creek, the remaining gages are on Beaverdam Creek and the North Fork of Goose Creek. The two gages on the mainstem of Goose creek were used for TMDL development. The gages on Beaverdam Creek and the North Fork of Goose Creek were

installed in 2001 and the data has not been reviewed by USGS. Therefore, these gages were not used in the TMDL.

The HSPF model is calibrated by adjusting model parameters (within identified benchmarks) until there is an agreement between observed and simulated flows. The model's performance is then verified by holding the parameters constant and comparing the simulated flows with the observed flows of a different time period. Flows at USGS Gages 01644000 (Goose Creek, Leesburg) and 01643700 (Goose Creek, Middleburg) were modeled in the TMDL. Weather data is the driver of the TMDL model, it provides the climatological conditions which determine the model's flow. Weather data for these TMDLs were obtained from four weather stations in or around the watershed. The weather stations were the Plains, Mount Weather, Lincoln, and Dulles Airport. Generally, precipitation data were applied to a given modeling segment according to which station was closest to the centroid of the modeling segment.[3] Additional climatological data was obtained from Phase 4 of the Chesapeake Bay Program Watershed Model. This data was derived from the Dulles Airport weather station. During the calibration, point sources were modeled as discharging at observed flows and concentrations.

The calibration period for both USGS gage was 1988-1995. Flows below 0.001 cfs were modeled as being 0.001 cfs. This was done because of the difficulties in calculating the fecal coliform concentrations in flows below this value and the effects they would have on the geometric mean. As the flow approaches 0 cfs, the concentration of fecal coliform approaches infinity. This would therefore steer the geometric mean and the allocations. This was viewed by EPA as a proper procedure. The simulated flow at both stations compared favorably to the observed flow at the USGS gages. Validation was run from 1996-1997 at the Middleburg gage and 1998-2001 at the Leesburg gage.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained in the Goose Creek Watershed.

2) The TMDL includes a total allowable load as well as individual WLAs and LAs.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest, cropland, pasture 1, pasture 2, high density residential, low density residential, and farmstead), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, and straight pipes), and point sources. Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in

[3]ICPRB. 2003. Bacteria TMDLs for the Goose Creek Watershed.

Table 1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Wasteload Allocations

Virginia has stated that there are several point sources discharging fecal coliform (e-coli) to Goose Creek and its impaired tributaries. The majority of these point sources are single family residential sewage treatment facilities. The single family residential sewage treatment plants are covered by Virginia general permit VAG40. These facilities are allowed to discharge 1,000 gallons per day with a fecal coliform concentration of 200 cfu/100 mL or an e-coli concentration of 126 cfu/100mL. Therefore, these facilities were given a WLA of 2.76E+9 for fecal coliform. Their WLA was determined by multiplying their allowable concentration (200 cfu/100 mL) by their permitted flow of 1,000 gallons per day (3,790,000 ml/day) by the number of days in a year (365). The same procedure was done for the remaining facilities which have differing flows but the same allowable concentration. Since these facilities were discharging at water quality standards no reductions were needed as they were not causing or contributing to violations of criteria. The WLAs are illustrated on Table 2.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 - WLAs for Goose Creek TMDLs

Stream	Facility	Permit Number	Allocated Load Fecal Colifom	Allocated Load E-Coli
North Fork of Goose Creek	Purcellville STP	VA0022802	1.38E+12	8.70E+11
North Fork of Goose Creek	Round Hill WWTP	VA0026212	5.51E+11	3.48E+11
North Fork of Goose Creek	Residence	VAG406146	2.76E+09	1.74E+09
North Fork of Goose Creek	Residence	VAG406176	2.76E+09	1.50E+11
Beaverdam Creek	St Louis	VA0062189	2.38E+11	1.74E+09
Beaverdam Creek	Business	VAG406016	2.76E+09	1.74E+09

Beaverdam Creek	Residence	VAG406115	2.76E+09	1.74E+09
Beaverdam Creek	Residence	VAG406135	2.76E+09	1.74E+09
Beaverdam Creek	Residence	VAG406143	2.76E+09	1.74E+09
Beaverdam Creek	Residence	VAG406149	2.76E+09	1.74E+09
Beaverdam Creek	Residence	VAG406116	2.76E+09	1.74E+09
Little River	Residence	VAG406019	2.76E+09	1.74E+09
Sycolin Creek	Business	VAG406172	2.76E+09	1.74E+09
Goose Creek	US FEMA	VA0024759	2.49E+11	1.57E+11
Goose Creek	Middleburg	VA0024775	3.72E+11	2.35E+11
Goose Creek	Foxcroft	VA0024112	2.07E+11	1.31E+11
Goose Creek	Notre Dame	VA0027197	4.16E+10	2.61E+10
Goose Creek	Goose Creek	VA0080993	2.76E+10	1.74E+10
Goose Creek	Aldie WWTP	VA0089133	4.16E+10	2.61E+10
Goose Creek	Residence	VAG406018	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406020	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406047	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406069	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406101	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406113	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406115	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406121	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406170	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406193	2.76E+09	1.74E+09
Goose Creek	Residence	VAG406244	2.76E+09	1.74E+09

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint

source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the Goose Creek Watershed. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality for conventional pollutants and toxicants[4]. HSPF uses precipitation data for continuous and storm event simulation to determine total fecal coliform (e-coli) loading to Goose Creek and its impaired tributaries from forest, cropland, pasture, pervious developed, impervious developed, and barren. The total land loading of fecal coliform (e-coli) is the result of the application of manure and biosolids, direct deposition from cattle, other livestock and wildlife (geese, deer, etc.), the deposition of fecal coliform (e-coli) from failed septic systems, and fecal coliform production from pets.

In addition, VADEQ recognizes the significant loading of fecal coliform (e-coli) from cattle in-stream, straight pipes, and wildlife in-stream. These sources are not dependent on a transport mechanism to reach a surface waterbody, and therefore, can impact water quality during low and high flow events. Tables 3a - 3g identify the LA for each of the impaired segments within the Goose Creek Watershed. The LA for each stream is given in cfu/yr delivered to the edge of stream.

Table 3a - LA for Cromwells Run

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	4.45E+12	4.45E+12	0%
Cropland	6.61E+10	6.61E+10	0%
Pasture	3.57E+14	3.57E+12	99%
Developed Land (w/o failing septic systems)	2.02E+11	2.02E+11	0%
Failing Septic Systems	2.93E+12	0	100%
Straight Pipes/Septic Systems within 50' of Surface Water	1.26E+06	0	100%
Direct Deposition from Cattle	1.22E+14	0	100%
Direct Deposition from Wildlife	1.51E+12	1.51E+12	0%

[4] Supra, footnote 2.

Table 3b - LA for North Fork Goose Creek

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	2.36E+11	2.36E+11	0
Cropland	5.18E+11	5.18E+11	0
Pasture	6.17E+14	1.23E+13	98
Developed Land (w/o failing septic systems)	3.93E+11	3.93E+11	0
Failing Septic Systems	4.75E+12	0	100
Straight Pipes/Septic Systems within 50' of Surface Water	3.56E+06	0	100
Direct Deposition from Cattle	3.63E+14	0	100
Direct Deposition from Wildlife	1.87E+12	1.87E+12	0
Total	9.89E+14	1.54E+13	98

Table 3c- LA for Beaverdam Creek

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	5.15E+12	5.15E+12	0
Cropland	6.53E+11	6.53E+11	0
Pasture	1.38E+15	2.77E+13	98
Developed Land (w/o failing septic systems)	1.96E+10	1.96E+10	0
Failing Septic Systems	7.94E+12	0	100
Straight Pipes/Septic Systems within 50' of Surface Water	6.42E+06	0	100
Direct Deposition from Cattle	5.44E+14	0	100
Direct Deposition from	3.54E+12	3.54E+12	0

Wildlife			
Total	1.94E=15	3.70E+13	98

Table 3d - LA for Little River

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	8.03E+12	8.03E+12	0
Cropland	4.96E+11	4.96E+11	0
Pasture	1.16E+15	1.16E+13	99
Developed Land (w/o failing septic systems)	3.21E+11	3.21E+11	0
Failing Septic Systems	6.39E+12E	0	100
Straight Pipes/Septic Systems within 50' of Surface Water	2.40E+06	0	100
Direct Deposition from Cattle	5.04E+14	0	100
Direct Deposition from Wildlife	3.19E+12	3.19E+12	0
Total	1.68E+15	2.36E+13	99

Table 3e - LA for Sycolin Creek

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	1.34E+12	1.34E+12	0
Cropland	2.89E+11	2.89E+11	0
Pasture	1.98E+14	3.96E+12	98
Developed Land (w/o failing septic systems)	1.75E+10	1.75E+10	0
Failing Septic Systems	1.83E+12	0	100
Straight Pipes/Septic Systems within 50' of Surface Water	0	0	0
Direct Deposition from	5.44E+13	0	100

Cattle			
Direct Deposition from Wildlife	6.14E+11	6.14E+11	0
Total	2.56E+14	6.22E+12	98

Table 3f - LA South Fork Sycolin Creek

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	4.93E+11	4.93E+11	0
Cropland	9.38E+08	9.38E+08	0
Pasture	3.76E+13	7.52E+11	98
Developed Land (w/o failing septic systems)	0	0	0
Failing Septic Systems	4.34E+11	0	100
Straight Pipes/Septic Systems within 50' of Surface Water	0	0	0
Direct Deposition from Cattle	9.05E+12	0	100
Direct Deposition from Wildlife	1.63E+11	1.63E+11	0
Total	4.77E+13	1.41E+12	97

Table 3g - LA for Goose Creek

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	6.37E+13	6.37E+13	0
Cropland	3.81E+13	3.81E+13	0
Pasture	1.12E+16	2.24E+14	98
Developed Land (w/o failing septic systems)	9.25E+12	9.25E+12	0

Failing Septic Systems	5.44E+13	0	100
Straight Pipes/Septic Systems within 50' of Surface Water	2.29E+07	0	100
Direct Deposition from Cattle	7.10E+15	0	100
Direct Deposition from Wildlife	2.87E+13	2.87E+13	0
Total	1.85E+16	3.63E+14	98

3) The TMDL considers the impacts of background pollution.

Background pollution was considered by evaluating the wildlife loading in the watershed.

4) The TMDL considers critical environmental conditions.

According to the EPA regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the Goose Creek Watershed is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[5]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum. These critical conditions ensure that water quality standards will be met for other than worst case scenarios.

The sources of bacteria for these stream segments were a mixture of dry and wet weather driven sources. Therefore, the critical condition for the Goose Creek Watershed was represented as a typical hydrologic year. Flows were modeled as not going below 0.001 cfs, if this was not done extreme low flows would have driven the TMDL model and allocations. Since the stream was modeled to attain the geometric mean and instantaneous criteria, the TMDL had to ensure that the long term

[5]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

bacteriological concentration remained below a specific threshold and insure that the instantaneous cap was not violated which occurs most often during periods of low or high flows.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis effectively considered seasonal environmental variations. The model also accounted for the seasonal variation in loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter.

6) The TMDLs include a MOS.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL.

Virginia included an implicit MOS by modeling the point sources as discharging at design flow and permitted concentrations. The model was developed to a ten year period which experienced a wide range of flows and loads.

7) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDLs were written to insure that the applicable bacteria criteria are attained. The reductions needed to meet the instantaneous e-coli criteria were far more rigorous than the reductions required for the other criteria. Under these allocations over the course of the ten-year simulation, only two storm events produce daily average e-coli concentrations larger than 90% of the instantaneous e-

coli standard.[6] Otherwise the e-coli concentrations are well below the instantaneous criteria in the remainder of the simulation period. Therefore, the magnitude of reductions called for in the TMDL may not be needed to attain the standards since they were required for the loads associated with two storm events during a ten-year study.

8) The TMDLs have been subject to public participation.

Three public meetings were held to discuss TMDL development on the Goose Creek Watershed. All of the public meetings were public noticed in the *Virginia Register* and advertised in the local papers (Fauquier Times Democrat, Loudon Times, and Fairfax Connection). The first two meetings were held in the Loudoun County Government Center in Leesburg, Virginia. The first two meetings were held on October 17, 2001 and November 14, 2001. The third meeting was held in the Marshall Community Center in Marshall, VA, on November 20, 2002. A total of nine people attended the first two meetings and five people attended the third meeting. The TMDLs were open to a 30-day public comment period. In addition to EPA, two other groups (Loudoun Watershed Watch and Piedmont Environmental Council) provided comment on the TMDLs.

[6]ICPRB. 2003. Bacteria TMDLs for the Goose Creek Watershed.